CHAPTER 3

WATERWAY TRAFFIC

3-1. General. The development of inland waterways for navigation usually can only be justified on the basis of commercial traffic. Therefore, design of the waterway should consider the types of equipment that would be using the waterway and their principal characteristics. River commerce in the United States is handled chiefly by barge tows consisting of a towboat pushing one or more barges, depending on the characteristics of the waterway, facilities provided, type of cargo, and size and power of the towboat. The tow speed and direction are controlled by the towboat, which is at the stern; the head of the tow is at the other end, sometimes from one barge length to more than 1200 feet away. Towboats vary in size, power, and maneuverability and, therefore, in their capability for handling loads under various conditions. Figure 3-1 indicates some of the equipment in more general use in the United States at this time (1979) and figure 3-2 indicates some of the barge and tow configurations used by the towing industry.

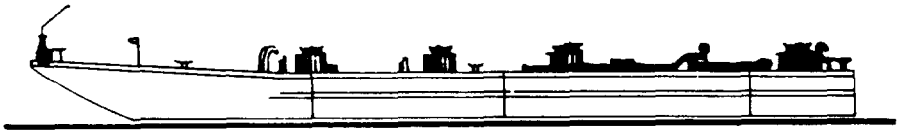
3-2. Towboat Controls. The towboat pilot is usually a considerable distance from the head of the tow, and his only means of control of the tow(s) is the action of the towboat rudder and propeller screws. The pilot's control of the tow depends on the maneuverability and power of the towboat, and the ability to anticipate the effects of currents, navigation aids provided, and visibility. The power of the towboat and the action of the rudder affect the movement of the tow, as do the direction and velocity of currents, wind, ice, drift, and channel dimensions. The towboat rudder or rudders develop a side thrust when placed at an angle to the direction of flow. This thrust is proportional to the area of the rudder affecting the currents, the angle of the rudder to the currents, and the square of the velocity of the currents directed against the rudder by the propeller in relation to the speed of the towboat. When a towboat is reducing speed in relation to the velocity of currents, it is losing rudder power; and when moving in the same direction and at the speed of the currents, the tow has no rudder control. When a towboat changes directions, the action of the rudder moves the stern of a forward-moving tow in a direction opposite to that of the turn. The pivot point of the turn from a standing position in slack water is some distance forward of the midpoint (about 30 percent of its length from the head of the tow). When the tow is under way and proceeding ahead, the pivot point moves forward and could be some distance beyond the head of the tow depending on the speed of the tow and the direction of the currents in relation to that of the tow. This explains why the stern of a tow will not necessarily follow the same path as the head when

OPEN HOPPER BARGES

TYPE	LENGTH FEET	BREADTH FEET	DRAFT FEET	CAPACITY TONS
STANDARD	175	26	9	1000
JUMBO	195	35	9	1500
SUPER JUMBO	250-290	40-52	9	2500-3000

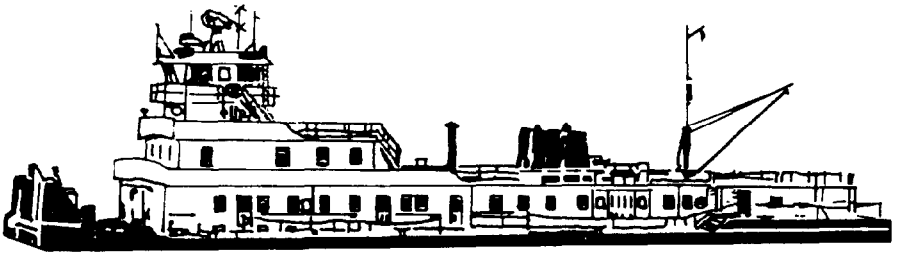
COVERED HOPPER BARGES

TYPE	LENGTH FEET	BREADTH FEET	DRAFT FEET	CAPACITY TONS
STANDARD	175	26	9	1000
JUMBO	195	35	9	1500



INTEGRATED CHEMICAL AND PETROLEUM BARGES

LENGTH FEET	BREADTH FEET	DRAFT FEET	CAPACITY TONS
150-300	50-54	9	1900-3000



TOWBOATS

LENGTH FEET	BREADTH FEET	DRAFT FEET	HORSEPOWER
65-160	24-50	5-9	300-7000

Figure 3-1. Predominant barge and tow types

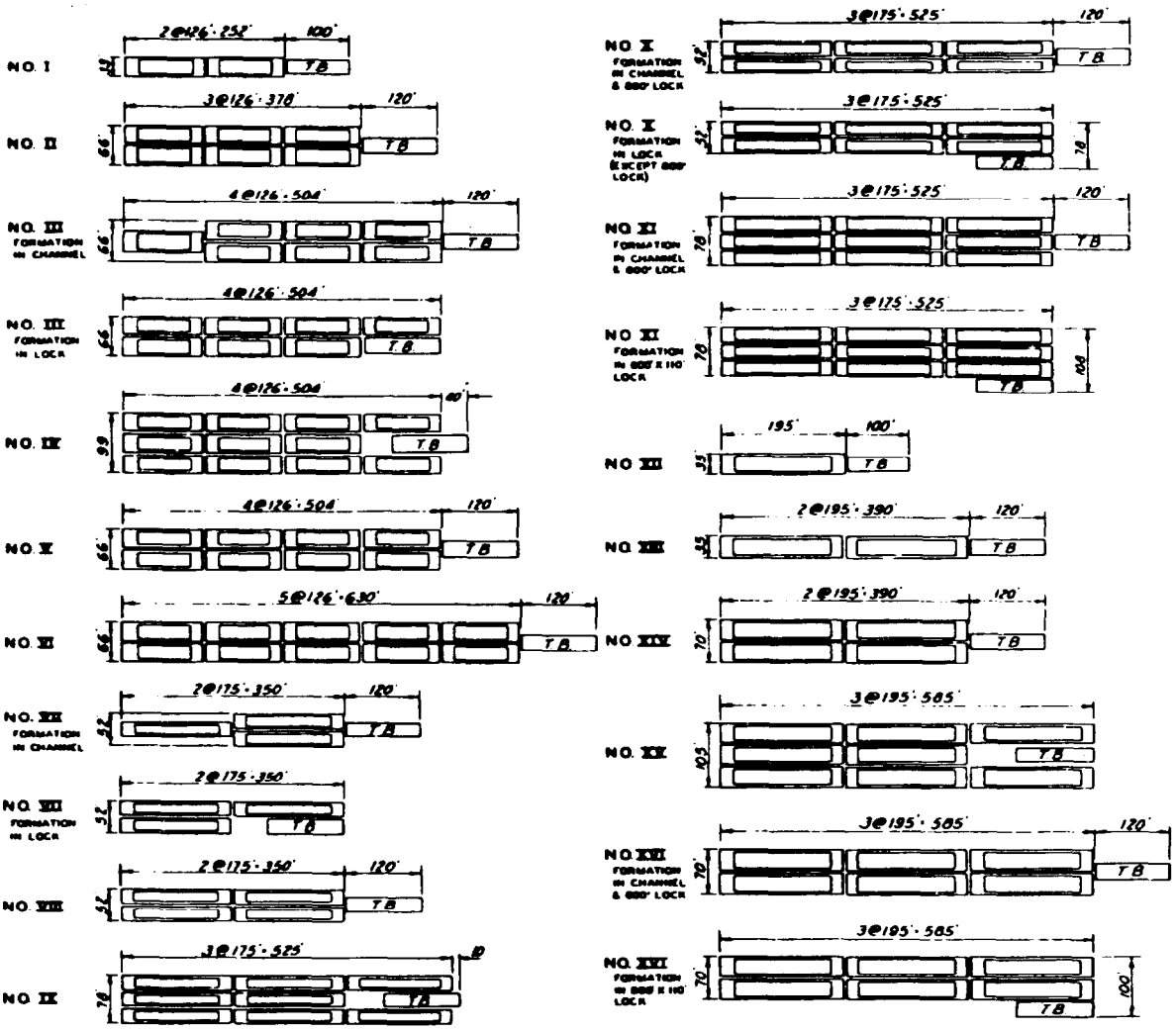


Figure 3-2. Typical arrangements for barge tows

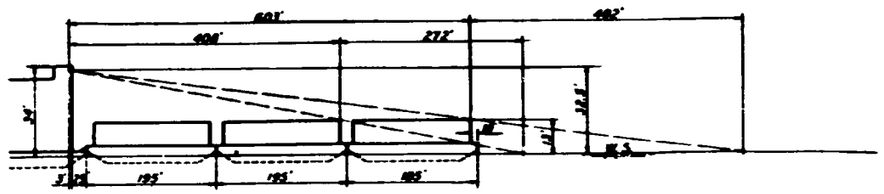
turning, going around bends, or attempting to compensate for adverse currents.

3-3. Maneuverability of Tows. The maneuverability of towboats varies depending on the size and number of rudders, power versus load of the towboat, and special equipment, such as Kort nozzles or bow steerers. Most towboats are equipped with flanking rudders which operate when the screws are reversed (backing) and which can be used in negotiating sharp bends and to assist in maneuvering the tow for the approach to

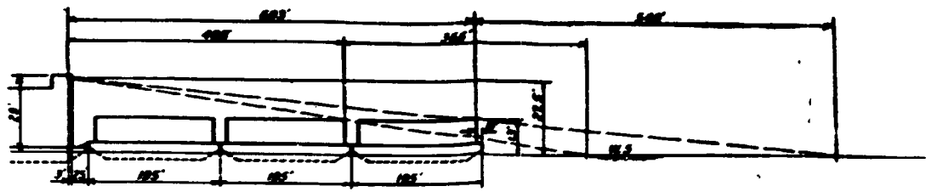
the lock or in negotiating critical reaches. A flanking maneuver consists of reversing the screws to retard the movement of the tow and thus permitting currents to swing the head of the tow in the desired direction or to move the stern of the tow laterally. Since flanking is greatly dependent on the direction and alignment of the currents, the head of the tow cannot always be moved into the desired position by flanking alone. Towboats having independently controlled twin screws can develop a twisting action to provide some control of the movement of the head of the tow by having one screw pushing ahead and the other in reverse. Flanking or maneuvering increases the time and power required to move the load, thereby increasing the cost of operating the tow. Bow steerers, which are power units located in the bow of the towboat or lead barge, can improve the maneuverability of tows considerably; however, for various reasons, these are not in general use. Design of navigation facilities should consider that special steering devices generally will not be available and that some towboats will be operating with power insufficient for the safe handling of their loads.

3-4. Visibility. Good visibility is required to locate channel markers, traffic in the area, bridge piers, and navigation aids. Visibility can be affected by weather conditions such as heavy fog, rain, or snow; channel alignment; and location of the pilot with respect to the head of the tow. Sight distance can be limited by bends in the alignment of the channel, location of islands on high sandbars, or structures along the banks. The effect of tow configuration and elevation of the pilot house is illustrated in figure 3-3. The types of navigation aids available to assist pilots in negotiating critical reaches and the traffic control that could be provided for safety should be determined in coordination with the U. S. Coast Guard during early stages of planning.

3-5. Effects of Currents. Adverse currents can cause or contribute to accidents and delays in navigation. Tows are affected by the velocity and alignment of currents relative to the path of the tow. Currents moving at an angle to the path of the tow are referred to as crosscurrents. These currents can be encountered in river crossings, in bends, near side or divided channels, in the entrances to canals, and in the approaches to locks. The velocity of currents in the stream can affect the intensity of the crosscurrents, increase the time of travel and power required for tows moving in an upstream direction, and affect the maneuverability and control of tows moving in a downstream direction. Wind blowing across the path of a tow, particularly one with empty barges, can also have a serious effect on the maneuverability of the tow.

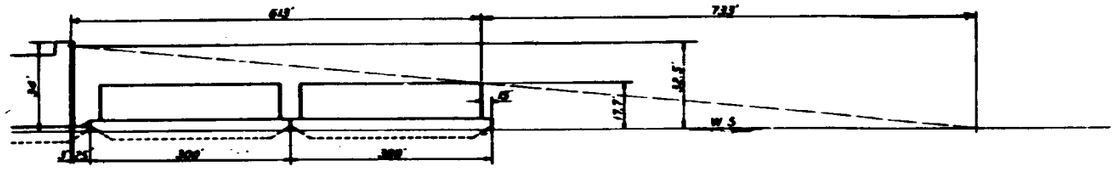


CASE I



CASE II

CASE III



CASE IV

CASE I

Low sheet of bridges 35' above W.S.
Assume highest point of boat 34' above W.S.
Assume point of pilot's eye to be 32.5' above W.S.

CASE II

Low sheet of bridges 30' above W.S.
Assume highest point of pilot house 29' above W.S.
Assume point of pilot's eye to be 27.5' above W.S.

CASE III

Low sheet of bridges 25' above W.S.
Assume highest point of pilot house 24' above W.S.
Assume point of pilot's eye to be 22.5' above W.S.

CASE IV

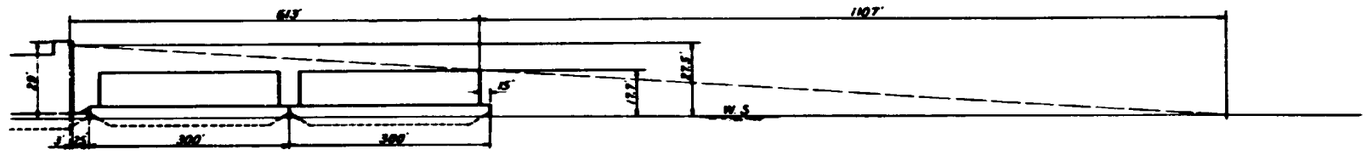
Low sheet of bridges 30' above W.S.
Assume highest point of pilot house 34' above W.S.
Assume point of pilot's eye to be 32.5' above W.S.

CASE V

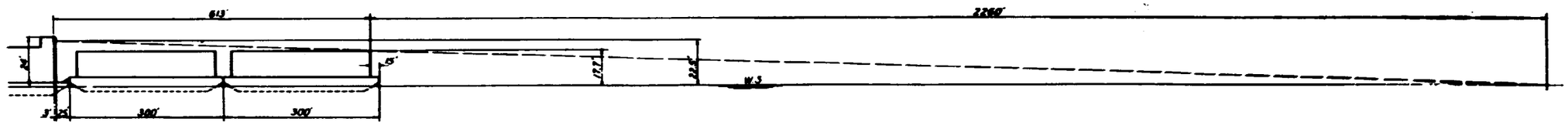
Low sheet of bridges 30' above W.S.
Assume highest point of pilot house 29' above W.S.
Assume point of pilot's eye to be 27.5' above W.S.

CASE VI

Low sheet of bridges 25' above W.S.
Assume highest point of pilot house 24' above W.S.
Assume point of pilot's eye to be 22.5' above W.S.



CASE V



CASE VI

Notes
1. *Cases I, II, & III cover 195'x 35' barges belonging to Central Barge Co., A. L. Mechling Co., Marquette Cement Mfg. Co., Socony Vacuum Oil Co. and Defense Plant Corporation.*
2. *Cases IV, V, & VI cover 300'x 48' barges belonging to Federal Barge Lines.*

Figure 3-3. Sight analysis